ATMOSPHERE/ENERGY UNDERGRADUATE MAJOR

Atmosphere/Energy (A/E)

Completion of the undergraduate program in Atmosphere/Energy leads to the conferral of the Bachelor of Science in Engineering. The subplan "Atmosphere/Energy" appears on the transcript and on the diploma.

Mission of the Undergraduate Program in Atmosphere/Energy

Atmosphere and energy are strongly linked: fossil-fuel energy use contributes to air pollution, global warming, and weather modification; and changes in the atmosphere feed back to renewable energy resources, including wind, solar, hydroelectric, and wave resources. The mission of the undergraduate program in Atmosphere/Energy (A/E) is to provide students with the fundamental background necessary to understand large- and local-scale climate, air pollution, and energy problems and solve them through clean, renewable, and efficient energy systems. To accomplish this goal, students learn in detail the causes and proposed solutions to the problems, and learn to evaluate whether the proposed solutions are truly beneficial. A/E students take courses in renewable energy resources, indoor and outdoor air pollution, energy efficient buildings, climate change, renewable energy and clean-vehicle technologies, weather and storm systems, energy technologies in developing countries, electric grids, and air quality management. The curriculum is flexible. Depending upon their area of interest, students may take in-depth courses in energy or atmosphere and focus either on science, technology, or policy. The major is designed to provide students with excellent preparation for careers in industry, government, and research; and for study in graduate school.

Requirements

Mathematics and Science (45 units minimum):

Mathematics 23 units minimum, including at least one course from each group:

**Group A**
- MATH 53 Ordinary Differential Equations with Linear Algebra
- CME 102 Ordinary Differential Equations for Engineers

**Group B**
- CME 106 Introduction to Probability and Statistics for Engineers
- STATS 60 Introduction to Statistical Methods: Precalculus
- STATS 101 Data Science 101
- STATS 110 Statistical Methods in Engineering and the Physical Sciences

Science 20 units minimum, including all of the following:

- PHYSICS 41 Mechanics
- or PHYSICS 41E Mechanics, Concepts, Calculations, and Context
- PHYSICS 43 Electricity and Magnetism
- or PHYSICS 45 Light and Heat
- CHEM 31B Chemical Principles II
- or CHEM 31X Chemical Principles Accelerated
- CEE 70 Environmental Science and Technology 1

Technology in Society (1 course) 3-5 units minimum, including at least one of the following:

- EARTHSYS 196 Implementing Climate Solutions at Scale 5
- EARTHSYS 200 Environmental Communication in Action: The SAGE Project
- EARTHSYS 111 Biology and Global Change 5
- EARTHSYS 144 Understanding Energy - Essentials
- ENGR 101A Energy: Chemical Transformations for Production, Storage, and Use
- ENGR 107A Managing Sustainable Building Projects
- EARTHSCI 142 Fundamentals of Geographic Information Science (GIS)
- EARTHSCI 188 Social and Environmental Tradeoffs in Climate Decision-Making 5
- ME 131B Fluid Mechanics: Compressible Flow and Turbomachinery
- PHYSICS 199 The Physics of Energy and Climate Change 5
- EARTH 2 Climate and Society 5
- OR one of these WIM courses (do not fulfill TiS):
  - BIOE 131 Ethics in Bioengineering
  - COMM 120W Digital Media in Society
  - ENGR 25E Energy: Chemical Transformations for Production, Storage, and Use
  - ENGR 50E Introduction to Materials Science, Energy Emphasis
  - OR one of these WIM courses (do not fulfill TiS):
  - CEE 100 Introduction to Engineering Analysis
  - CEE 162I Understanding Energy - Essentials
  - CEE 161I Understanding Energy
  - EARTHSYS 111 Introduction to Materials Science, Energy Emphasis

Writing in the Major (WIM)

One 3-5 unit course required. Choose a TiS course that fulfills a WIM:

- EARTHSYS 196 Implementing Climate Solutions at Scale 5
- EARTHSYS 200 Environmental Communication in Action: The SAGE Project
- EARTHSCI 142 Fundamentals of Geographic Information Science (GIS)
- EARTHSCI 188 Social and Environmental Tradeoffs in Climate Decision-Making 5
- ME 131B Fluid Mechanics: Compressible Flow and Turbomachinery
- PHYSICS 199 The Physics of Energy and Climate Change 5
- EARTH 2 Climate and Society 5
- OR one of these WIM courses (do not fulfill TiS):
  - BIOE 131 Ethics in Bioengineering
  - COMM 120W Digital Media in Society
  - ENGR 25E Energy: Chemical Transformations for Production, Storage, and Use
  - ENGR 50E Introduction to Materials Science, Energy Emphasis

Fundamentals and Depth: At least 40 units total must be from the School of Engineering

Engineering Fundamentals

Two courses minimum (recommend 3), including at least one of the following:

- ENGR 25E Energy: Chemical Transformations for Production, Storage, and Use
- ENGR 50E Introduction to Materials Science, Energy Emphasis

Plus at least one of the following:

- ENGR 101A Energy: Chemical Transformations for Production, Storage, and Use
- ENGR 107A Managing Sustainable Building Projects
- EARTHSYS 200 Environmental Communication in Action: The SAGE Project

A third Fundamental is optional but recommended (3-4 units)

Engineering Depth

Required: 6-8 units, Introductory seminars may not count toward Engineering Depth 5

- CEE 64 Air Pollution and Global Warming: History, Science, and Solutions (cannot also fulfill science requirement)
- CEE 107A Understanding Energy
- or CEE 107S Understanding Energy - Essentials
- 34-36 units from the following with at least four courses from each group; at least 40 of the units in ENGR Fundamentals and Depth must be from the School of Engineering:

Group A: Atmosphere

- AA 100 Introduction to Aeronautics and Astronautics
- CEE 63 Weather and Storms
- CEE 101B or ME 70 Mechanics of Fluids Introductory Fluids Engineering
- CEE 161C Climate Decision-Making
- CEE 161I Atmosphere, Ocean, and Climate Dynamics: The Atmospheric Circulation
- CEE 162I Atmosphere, Ocean, and Climate Dynamics: The Ocean Circulation
- CEE 172 Air Quality Management
- CEE 178 Introduction to Human Exposure Analysis
- EARTHSYS 111 Biology and Global Change 5
- EARTHSYS 142 Remote Sensing of Land 5
- or EARTHSYS 144 Understanding Energy - Essentials

Group B: Energy

- EARTHSYS 196 Implementing Climate Solutions at Scale 5
- CEE 156 Building Systems

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CEE 173S  Electricity Economics
CEE 176A  Energy Efficient Buildings
CEE 176B  100% Clean, Renewable Energy and Storage for Everything
CEE 177S  Engineering and Sustainable Development
EARTHSYS 101  Energy and the Environment
EARTHSYS 102  Fundamentals of Renewable Power
ENERGY 104  Sustainable Energy for 9 Billion
ENGR 50E  Introduction to Materials Science, Energy Emphasis
MATSCI 144  Thermodynamic Evaluation of Green Energy Technologies
MATSCI 156  Solar Cells, Fuel Cells, and Batteries: Materials for the Energy Solution
ME 182  Electric Transportation
POLISCI 73  Energy Policy in California and the West
OSPSANTG 29  Sustainable Cities: Comparative Transportation Systems in Latin America
OSPSANTG 52

Total Units 95-101

1. Can count as a science requirement or Engineering Fundamental, but not both.
2. CEE 64 can count as a science requirement or as Engineering Depth, but not both.
3. ENGR 50E can count as Engineering Fundamental or Engineering Depth, but not both.
4. A course may only be counted towards one requirement; it may not be double-counted. All courses taken for the major must be taken for a letter grade if that option is offered by the instructor. Minimum Combined GPA for all courses in Engineering Fundamentals and Depth is 2.0.
5. Courses outside of the School of Engineering (SoE) do not count toward the 40 units of engineering coursework required in the Fundamentals plus Depth categories.

Honors Program
The A/E honors program offers eligible students the opportunity to engage in guided original research, or project design, over the course of an academic year. Interested student must adhere to the following requirements:

1. Prospective honors students write up and submit a 1-2 page letter applying to the honors program in A/E describing the problem to be investigated. The letter must be signed by the student, the current primary adviser, and the proposed honors adviser, if different, and submitted to the student services office in the Department of Civil and Environmental Engineering (CEE). The application must include an unofficial Stanford transcript. Applications must be received in the fourth quarter prior to graduation. It is strongly suggested that prospective honors students meet with the proposed honors adviser well in advance of submitting an application.
2. Students must maintain a GPA of at least 3.5.
3. Students must complete an honors thesis or project over a period of three quarters. The typical length of the written report is 15-20 pages. The deadline for submission of the report is to be decided by the honors adviser, but should be no later than the end of the third week in May.
4. The report must be read and evaluated by the student's honors adviser and one other reader. It is the student's responsibility to find and obtain both the adviser and the reader. At least one of the two must be a member of the Academic Council in the School of Engineering.
5. Students must present the completed work in an appropriate forum, e.g. in the same session as honors theses are presented in the department of the adviser. All honors programs require some public presentation of the thesis or project.
6. Students may take up to 10 units of CEE 199H Undergraduate Honors Thesis(optional). However, students must take ENGR 202S Directed Writing Projects or its equivalent (required). Units for the writing class are beyond those required for the A/E major.
7. Two copies of the signed thesis must be provided to the CEE student services office no later than two weeks before the end of the student’s graduation quarter.

For additional information and sample programs, see the Handbook for Undergraduate Engineering Programs (UGHB) (http://ughb.stanford.edu).